

The stratospheric aerosol trend

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(1) NASA Langley Research Center, Hampton, VA 23666, USA

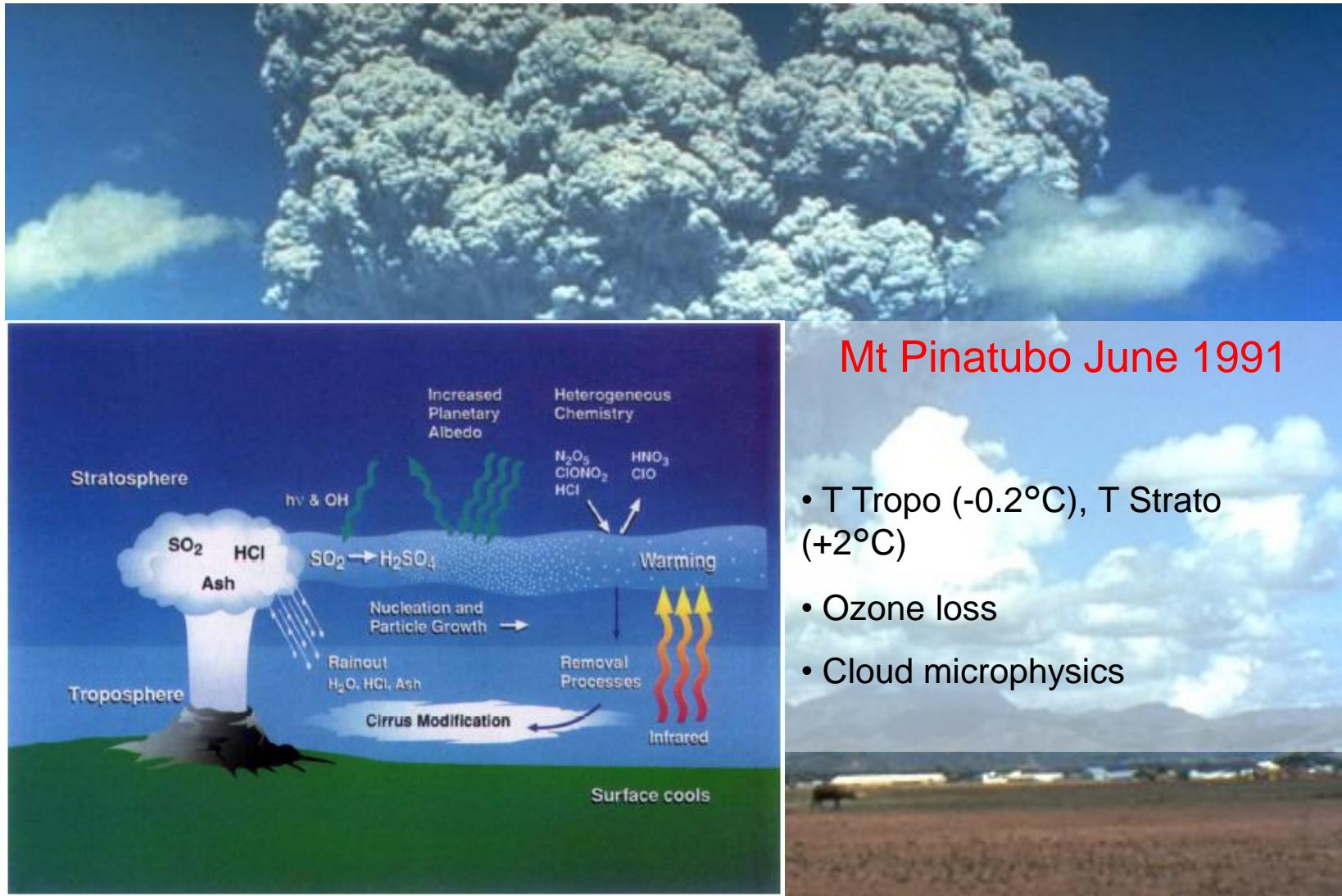
(2) LATMOS, CNRS-INSU, Université de Versailles St Quentin



NASA Langley day of education, October 2010

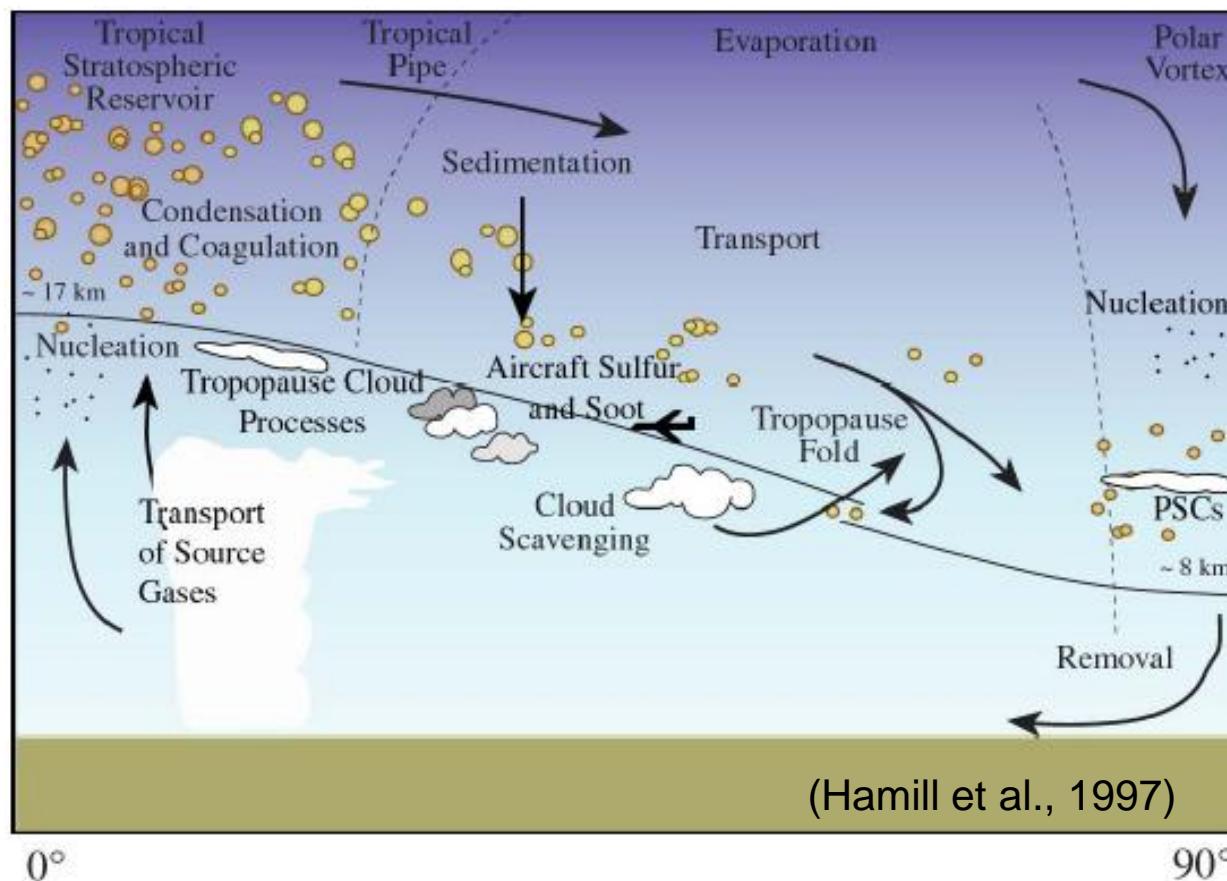
Magruder School, Newport News , VA

Impact of major volcanoes



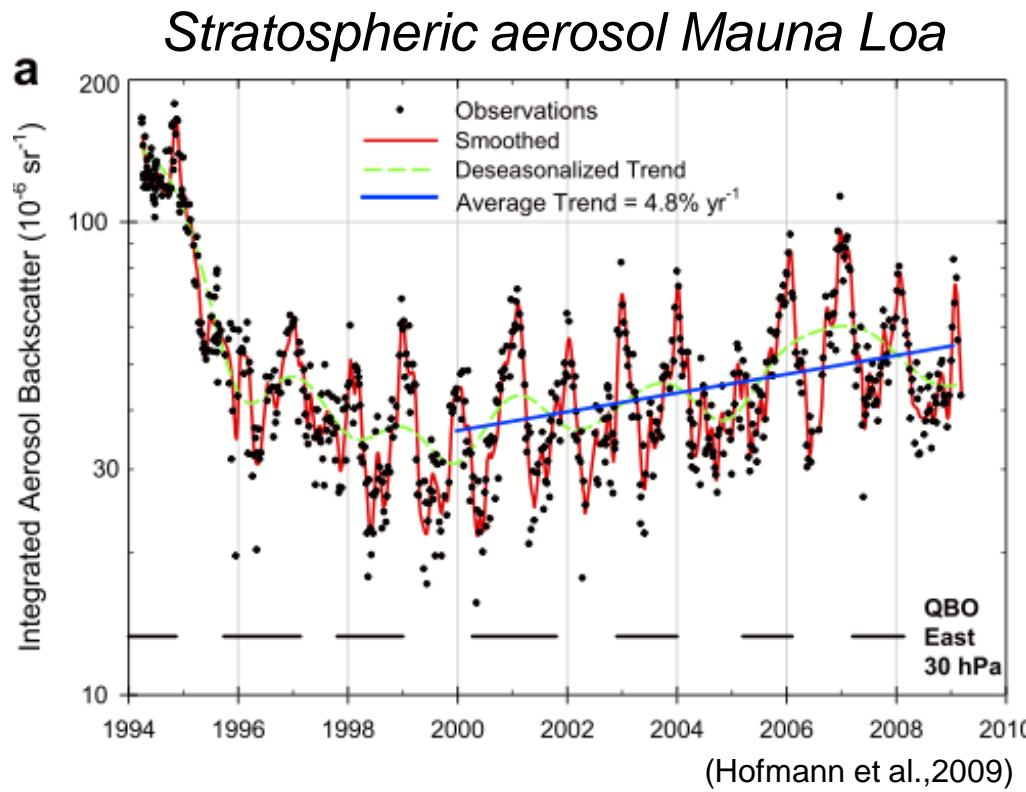
(McCormick et al., 1995)

Background period



- Permanent layer in the stratosphere (Junge layer)
- Nature : mixing H_2SO_4 et H_2O (75-25%)
- Origin ? : Transport of gaz precursors (OCS, DMS, SO₂) in the tropical UT/LS

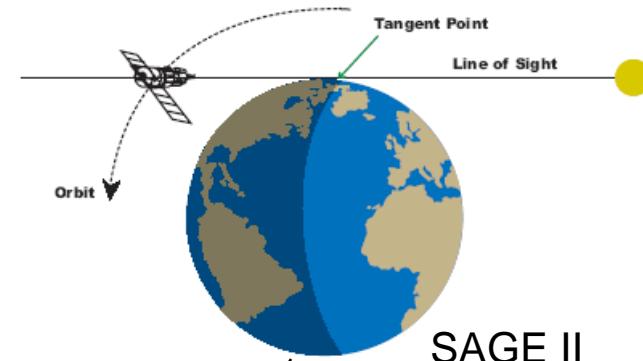
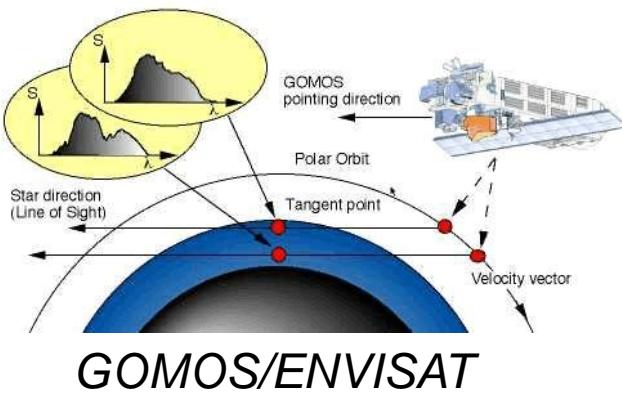
Positive trend in the stratosphere



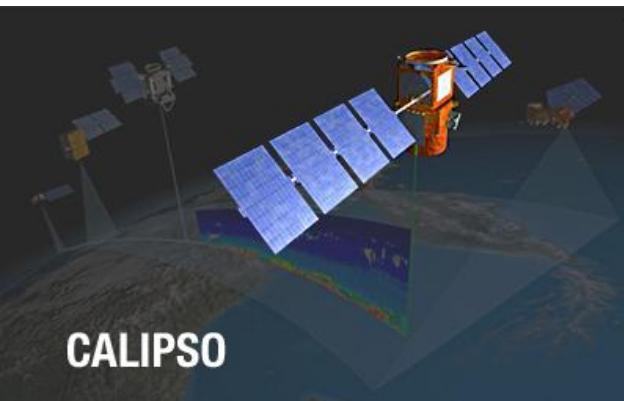
- Slow increase of 5%/yr since 2000
- Also reported by ground-based lidars in India and Japan (Kulkarni et al., 2006, Niwano et al., 2010)
- Possible influence of human emission of sulfur dioxide in Asia (Hofmann et al., 2009)



Instrumentation



Stratospheric
Aerosols



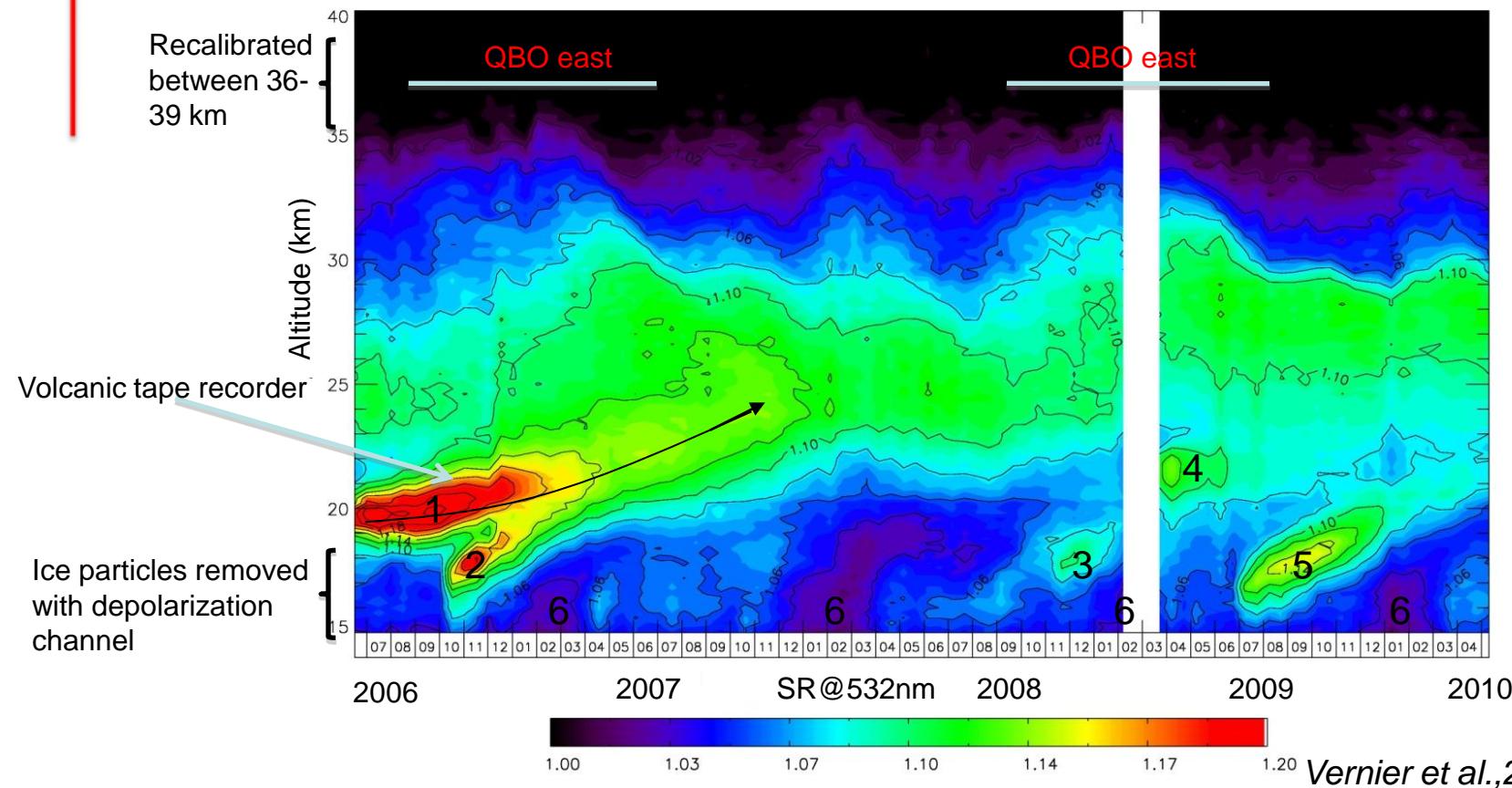
NDACC Lidars



OSIRIS/ODIN

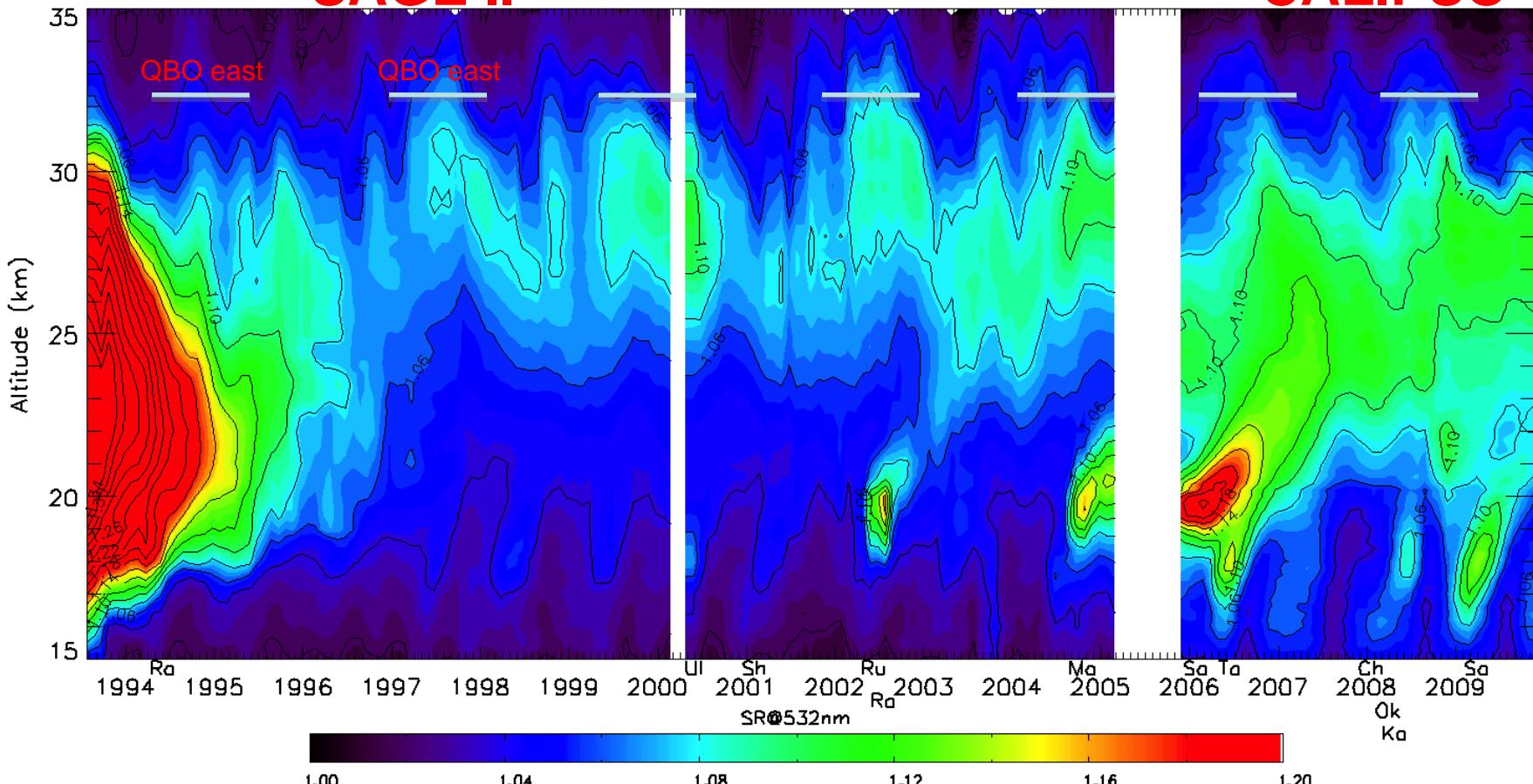
CALIPSO in the tropical stratosphere

CALIPSO 20N-20S; 2006-2010



1. Soufrière Hills	20-mai-06	16°N	4 ?	0.2Tg
2. Tavurvur	07-oct-06	4°S	4	
3. Kasatochi	07-août-08	55°N	4	1.5Tg
4. Fire Victoria	7-feb-08	45°S		
5. Sarychev	12-june-09	48°N	4	10Tg
6. Clean air	Winter-Spring			

Stratospheric aerosol levels since Pinatubo

SAGE II SR RECONSTRUCTED SAGEII+CALIPSO**CALIPSO**

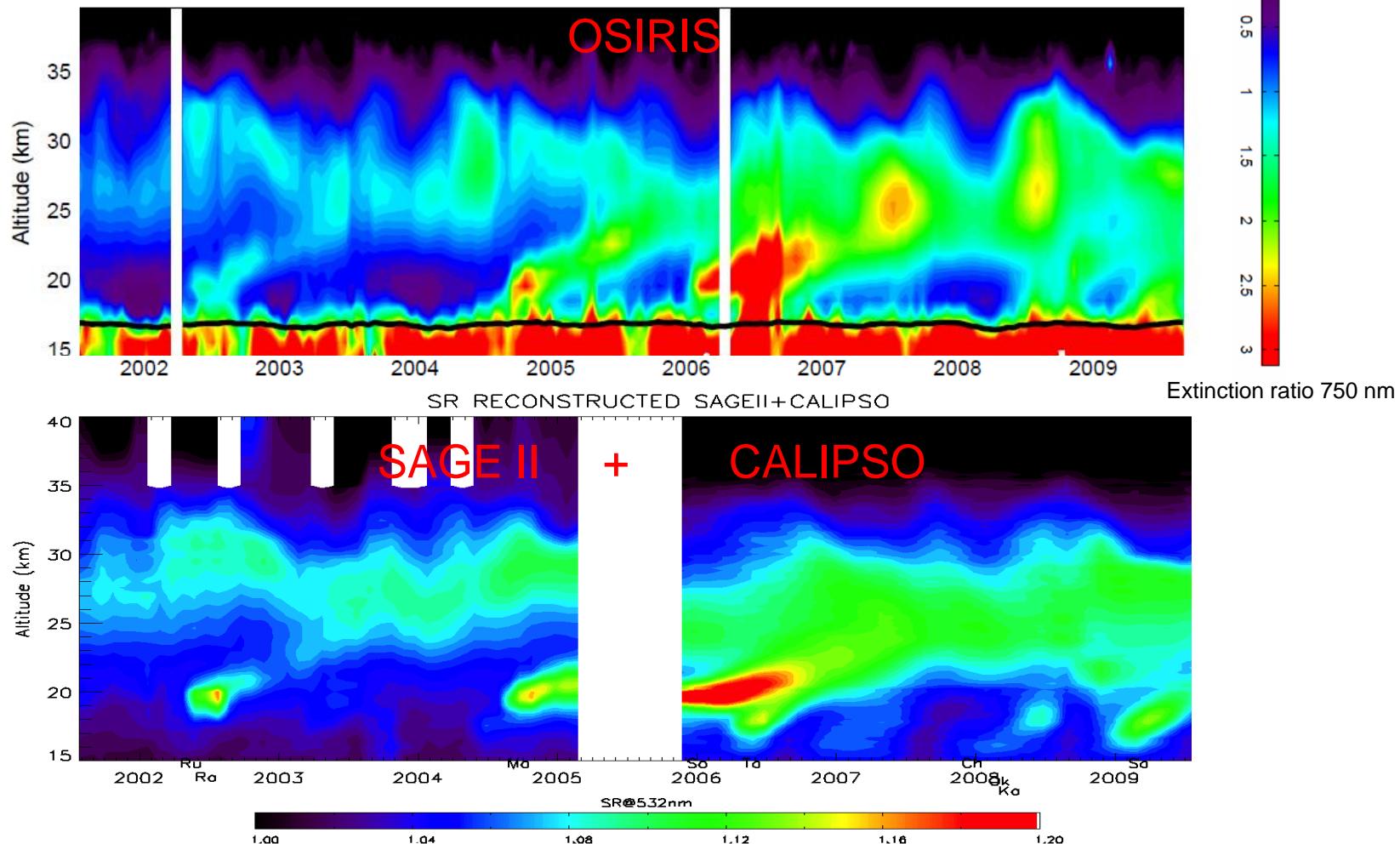
- 1994-1996 : Mt Pinatubo plume decay

- 1996-2002 : Relative clean period

- 2002-2010 : Important of Influence of moderate volcanic eruptions (VEI=4) ->

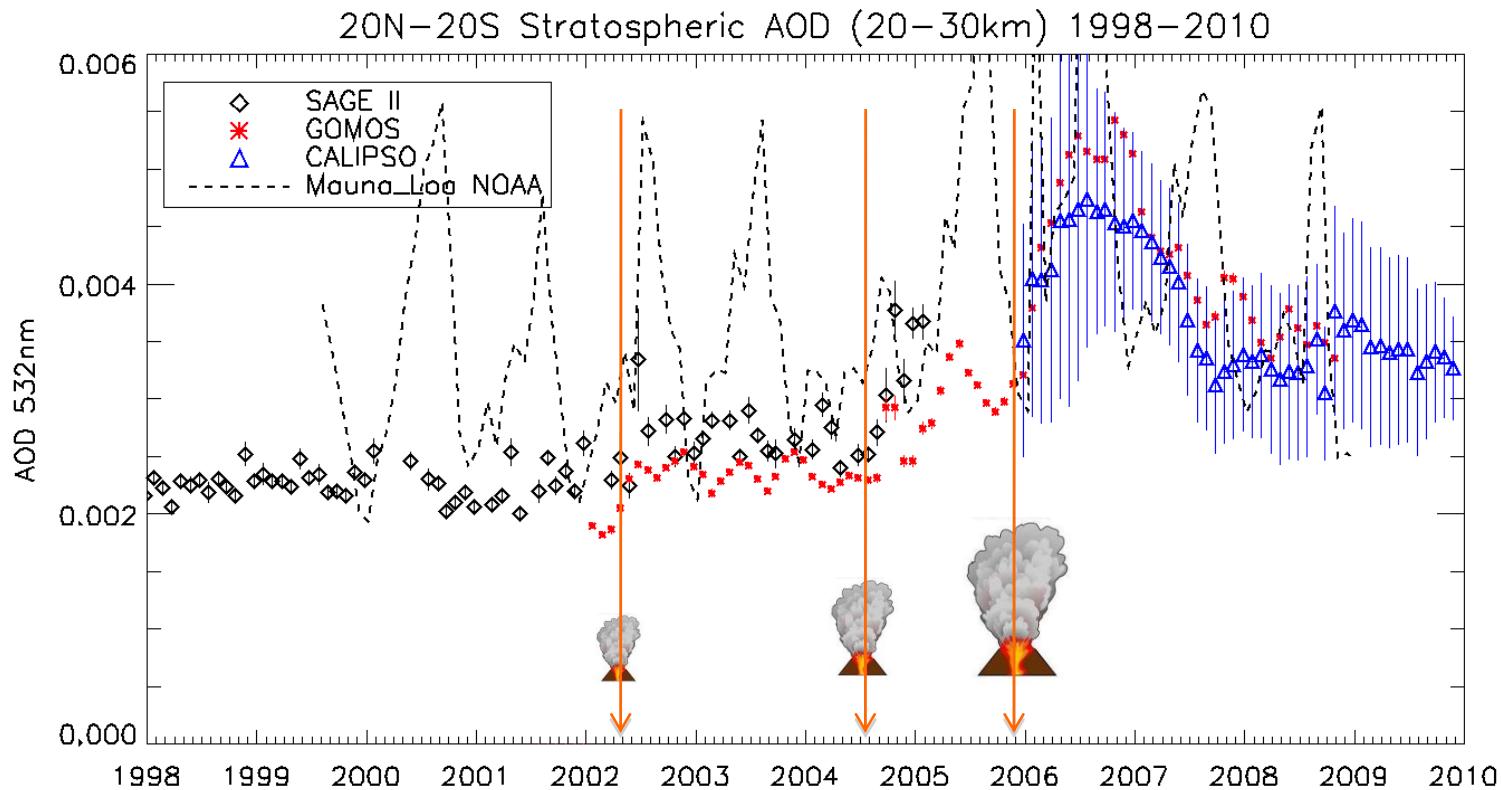
Ruang-Raventador (2002), Manam (2005), Soufriere Hills (2006)

Confirmation by OSIRIS-Odin



Same stratospheric features observed by OSIRIS

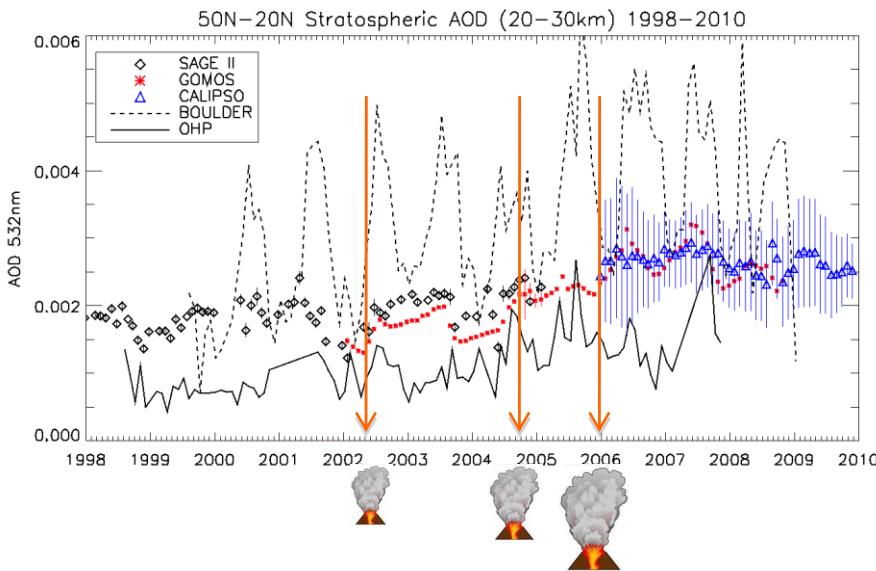
Stratospheric tropical AOD evolution since 1998



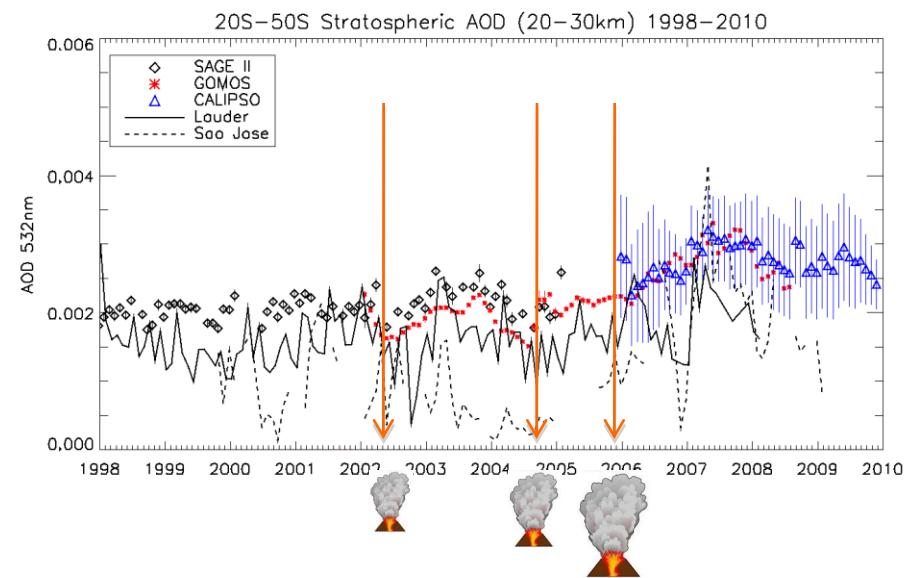
- Agreement between satellites through overlapping periods of measurements
- Strong annual cycle displayed in Mauna, not seen on satellites data : possible problems of calibration
- Increase in AOD after 2002 due to the influence of volcanic eruptions

Trend also observed at mid-latitude

50N-20N



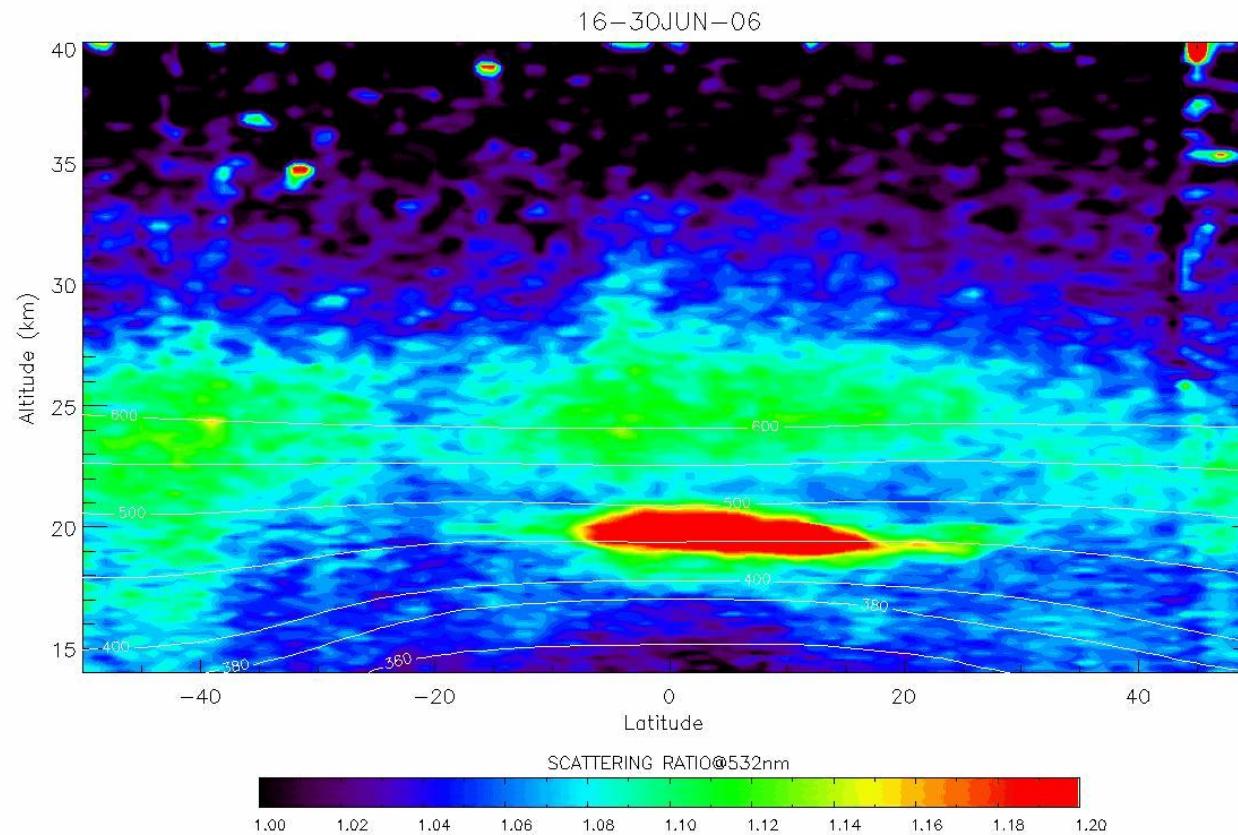
20S-50S



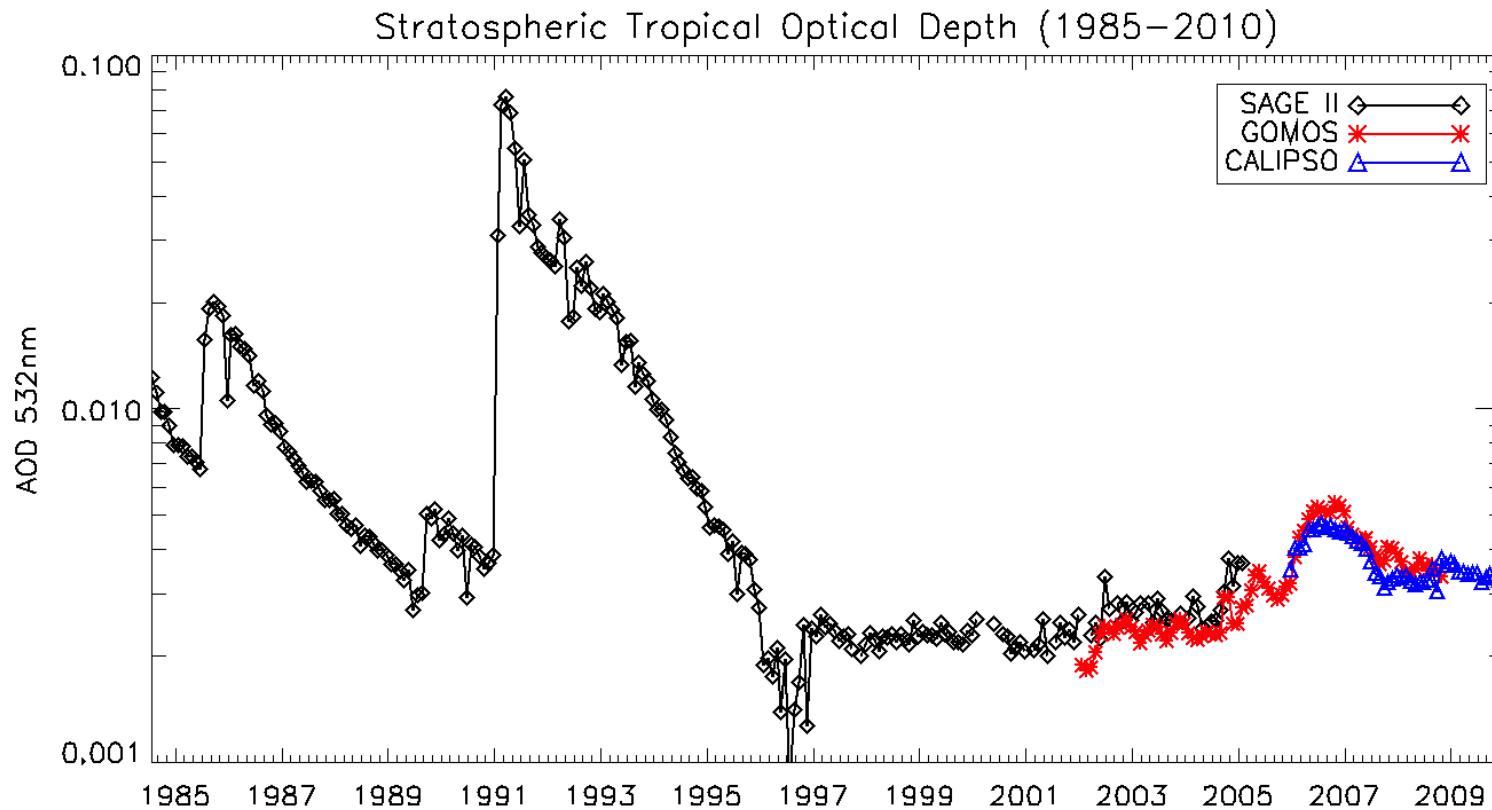
- Slow increase of the Stratospheric AOD 4-7%/year at mid-latitudes
- Delay of 6-12months compared to the tropics
- Combining effects of tropical eruption+transport

Dispersion of the volcanic plume in the global stratosphere

CALIPSO : June 2006-2008

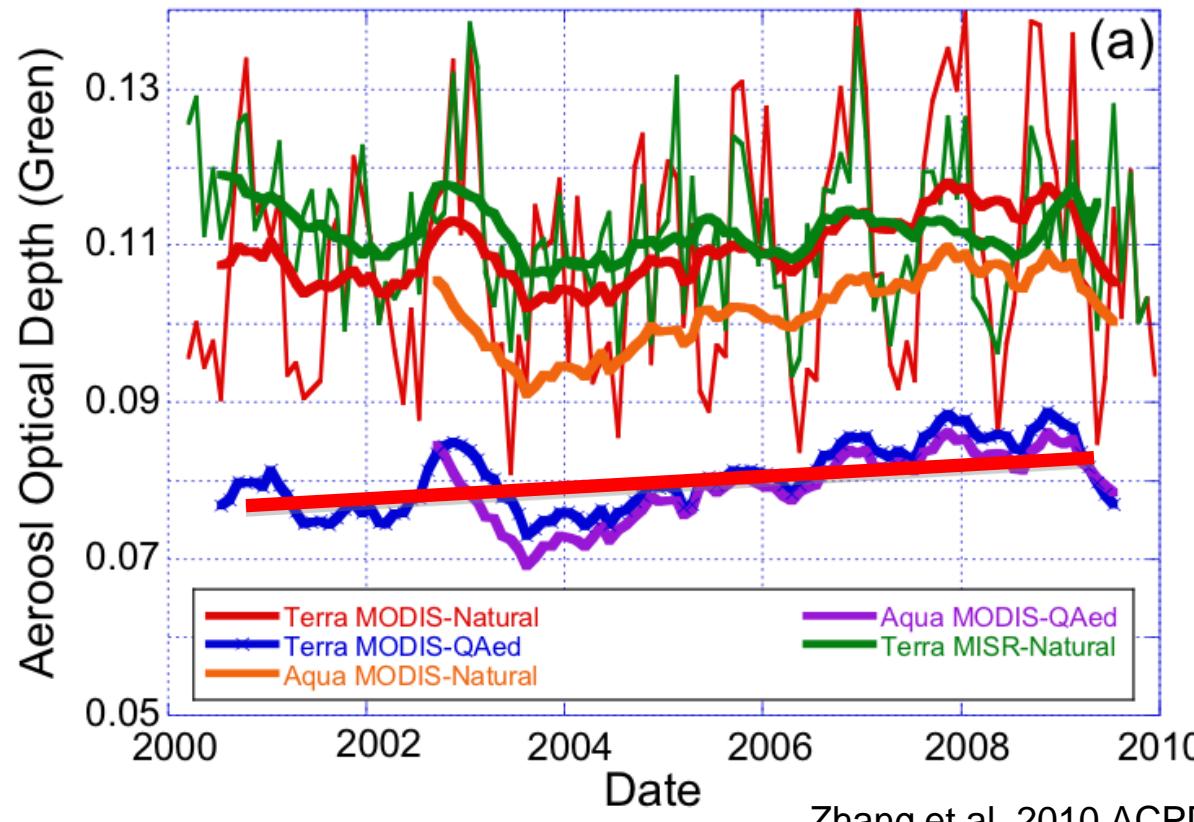


25 years of stratospheric aerosol record



- Stratospheric aerosol record from satellites since 1982
 - Important input from the A-train via CALIPSO : future mission required to continue the record like SAGE III/ISS 2014
 - Important also to know the stratospheric AOD for studying total AOD

Impact of the stratospheric trend on the total column



Zhang et al., 2010, ACPD

- Trend of 0.003/10years in AOD after correction of calibration deficiency on MODIS and MISR
- But same order than the trend in stratospheric aerosols
- > Need to take into account stratospheric AOD for studying global trend in AOD !

Conclusions

- Influence of minor volcanic eruptions (VEI=4) on the stratospheric aerosol background
- Trend observed since 2000 due to 3 consecutive volcanic eruptions
- No significant influence (still) of human activity compared to the volcanic source
- 25 years of stratospheric aerosol record with SAGE II, GOMOS, CALIPSO and expected to be completed by future missions SAGEIII/ISS



Contributors

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